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Investigating the effect of two species of mycorrhiza fungi and salinity on growth, function and chlorophyll content on Ocimum basilicum

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ABSTRACT: In order to investigate the effect of reconciliation of two species of mycorrhiza fungi and salinity on growth, function and chlorophyll content on Ocimum basilicum, a Pot experiment in factorial and completely randomized design with four replications was conducted on Ocimum basilicum L. Examined factors include three levels of salinity (1, 3 and 5 ds/m) and applying two species of mycorrhiza fungi (Glomus intraradices and Glomus mosseae). Results showed that salinity stress had a significant effect on traits such that with increasing salinity, root dry weight, shoot dry matter yield decreased. Plant inoculation with AM fungi compared with non-inoculated plants, the yield stress and non-stress conditions were salt. The results showed that the fungus G. mosseae decreased in salinity of the fungus G. intraradice. So it can be concluded that AM fungi increase nutrient uptake under saline conditions required stress so that improves growth and yield of basil.
Key words: mycorrhiza fungi ,Ocimum basilicum, salinity stress

INTRODUCTION

The use of chemical fertilizers in agricultural ecosystems not only cause damage to the physical structure, chemical and biologic soil, but also the quality of the produced products are strongly influenced. One of the most important agricultural problems in arid and semiarid regions of the salinity and the accumulation of salts in the soil surface will reduce the yield and acreage (Al-karaki and Hammad 2001).According to estimates of the United Nations Environment of approximately 20% of agricultural land and 50% of the world's arable agricultural lands are under salt stress (Flower and Yeo 1995). The present study examined the effects of two species of arbuscular mycorrhizal fungi on plant performance under salt stress and also examined that the basil mycorrhiza symbiotic with fungi that can be effective on salinity tolerance and basil root uptake and transport to shoots of the plant.

MATERIALS AND METHODS

This study investigated the effect of using two species of fungus Glomus intraradices and Glomus mosseae under salinity stress on growth and some physiological factors of basil, into a pot experiment was conducted in a greenhouse of Islamic Azad University. This factorial experiment was conducted in a completely randomized design with four replications. Salinity treatments consisted of three levels including 1, 3 and 5 ds m salinity mycorrhiza application of the two species G. intraradices and G. mosseae) and the non-application of fungus (control).

The sandy soil used for 1 h with a temperature of 121 ° C for 5 min and then rinsed with tap water sterilized pots, were surface sterilized by alcohol. Physical and chemical properties of soil were determined. The research field had a sandy loam soil. Details of soil properties are shown in Table 1.

Table 1. soil physical and chemical properties

. depth	Clay (%)	Silt (%)	Sand (%)	texture	EC (dS/m)	CEC (meq/100g)	O.C (%)	Total N (%)	Available P (ppm)	Available K (ppm)
0 - 30	12	23	65	Sandy Loam	1.50	6.4	0.8	0.09	7	120

Preparation of inoculum
According to Dan Kerr for surface disinfection, the seeds were soaked in 5% bleach for 7 min and were washed 8 to 10 times with distilled water. For each hole, a number of seed placements on the inoculum were covered with soil.

Wet weight of samples
Immediately after harvest, samples were placed in plastic bags and then transferred to the laboratory and were measured by a digital scale with an accuracy of one ten-thousandth

Dry weight of samples
Other dishes were immediately washed in tap water. Finally distilled water was placed in a paper bag full of leaching and. They were set and dried in laboratory condition. Weighing the samples after 24 h and cooling in desiccator by a digital scale was measured with an accuracy of one ten-thousandth. Measurement of leaf

chlorophyll
For determining chlorophyll a, b, total chlorophyll content of leaves Lichtenthaler and Wellburn, 1987 was used. For this purpose, 0.05 g leaves in 10 ml acetone and 80% pulverized was put. The obtained smooth was filtered with paper atman 1. Brought to a final volume of 20 ml and absorbance at wavelengths of 663/2 and 646/2 nm was measured using UV-Visible spectrophotometry. The concentration of chlorophyll a, b, and total chlorophyll content was determined by the following formulas.
Finally, all data were statistically analyzed using Spss software.

RESULTS AND DISCUSSION

The results of Duncan test indicated that in the salinity of 1 ds/m, the mean of fresh weight of plant roots is more than two groups of mycorrhizal. However, in salinity of 3 and 5 ds/m in groups of mycorrhizal, the root fresh weight was more than the control plants. Comparison of two fungal species showed that in salinity of 5 ds/m-1 fresh weight of root fungi fungus Glomose intraradices is more than glomos mossa. However, the salinity of 3 ds/m, the fresh weight of root in Glomose intraradices fungus is more than glomos mossa.

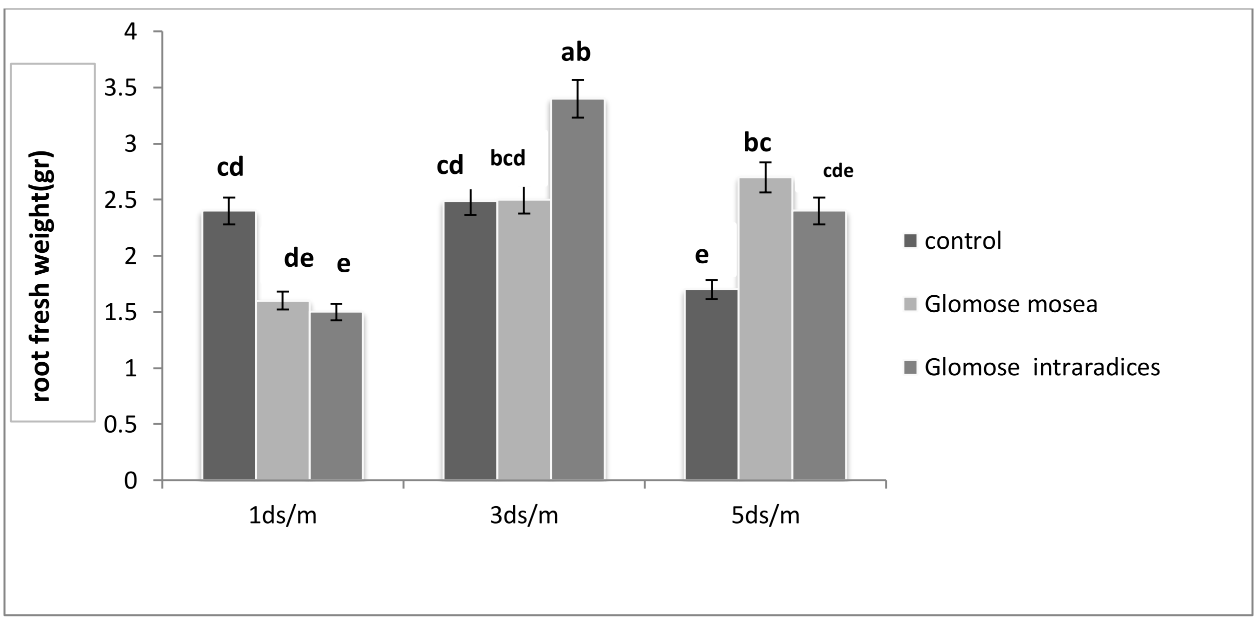

Figure 1. Interaction of salinity stress and mycorrhizal fungi on root fresh weight.

The results of Duncan test indicated that in the salinity of 1 ds/m, the average root dry weight of plants treated with fungal species of glomos mossa is more than the control plants and plants treated with mushroom species of Glomose intraradices. In the salinity of 3 ds/m, the root dry weight of basil plants treated with two kinds of mushrooms is more than the controlled plant, and dry weight of plants treated with Glomose intraradices fungus is more than the dry weight of plants treated with glomos mossa. Compared to the average salinity of 5 ds/m showed that root dry weight of plants treated with the fungus glomos mossa is more than the treated plants and control plants of Glomose intraradices fungus and root dry weight of control plants is more than fungi Glomose intraradices.

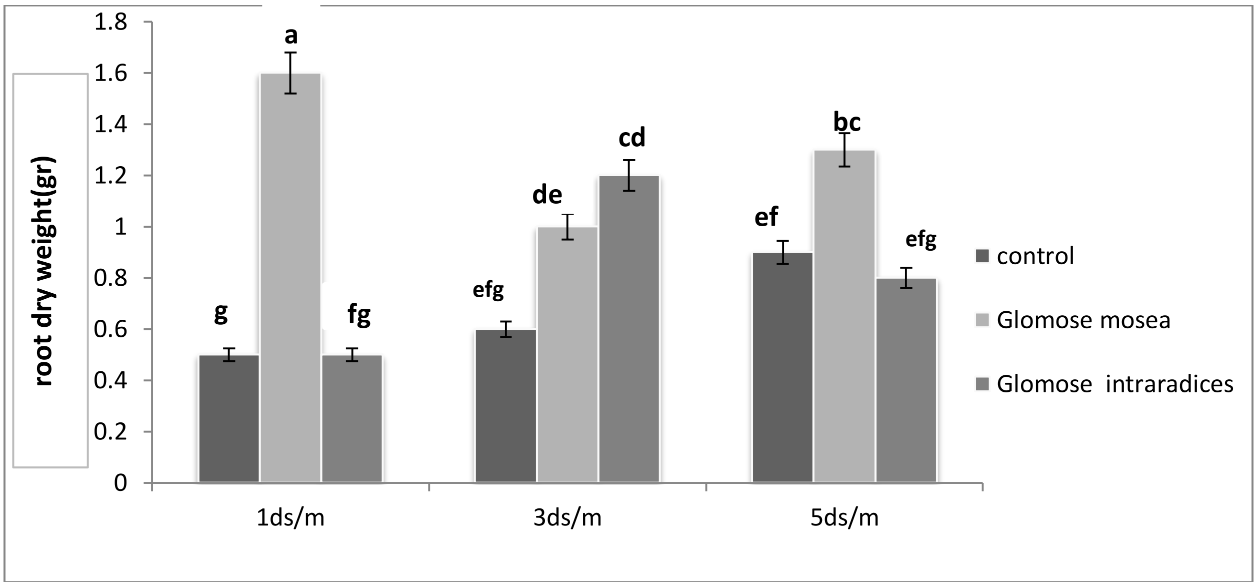

Figure 2. Interaction of salinity stress on mycorrhizal fungi and root dry weight.

The results of Duncan test indicated that in the salinity of 1 ds/m, the average fresh weight of shoots of control plants had no difference with treated plants with two species. However, in salinity of 3 and 5 ds/m the fresh shoots of mycorrhizal groups were greater than the control plants.

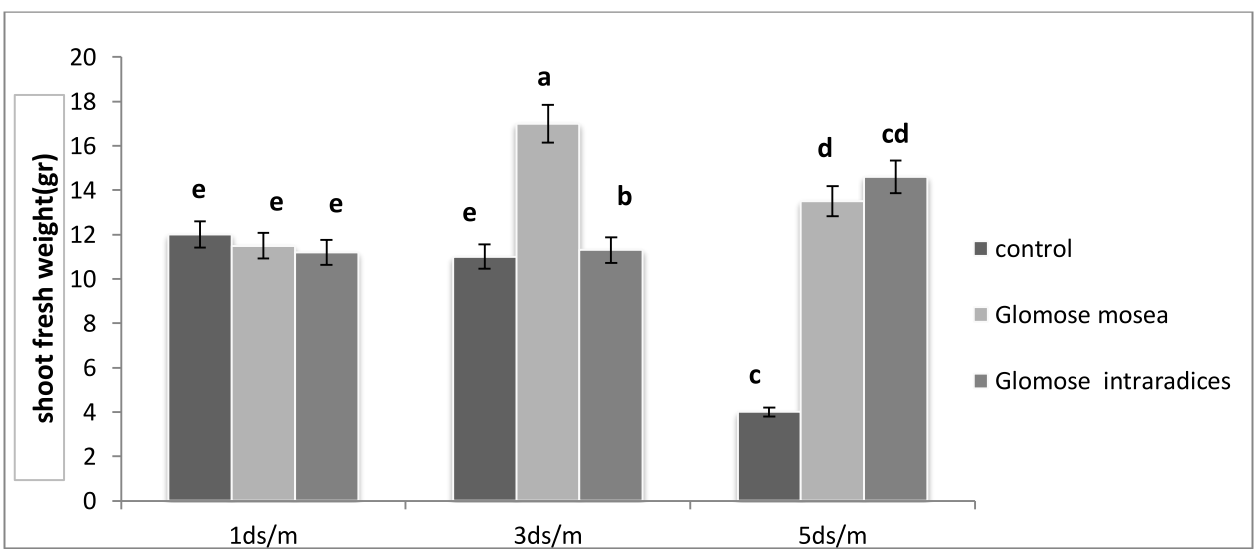

Figure 3. Interaction between mycorrhizal fungi of salt stress on shoot fresh weight

Obtained information from the comparing of mean shows a significance difference based on the mean weight of shoots and basil controls treated with two fungi. Duncan test results indicated that in the salinity of 1 ds/m, the average fresh weight of shoots of plants treated with more Glomose intraradices is more than control plants in glomos mossa. Also, fresh weight of shoots of plants treated with control plants is more than control plants in glomos mossa. However, in salinity of 3 and 5 ds/m, the fresh shoots of mycorrhizal groups, are greater than the control plants.

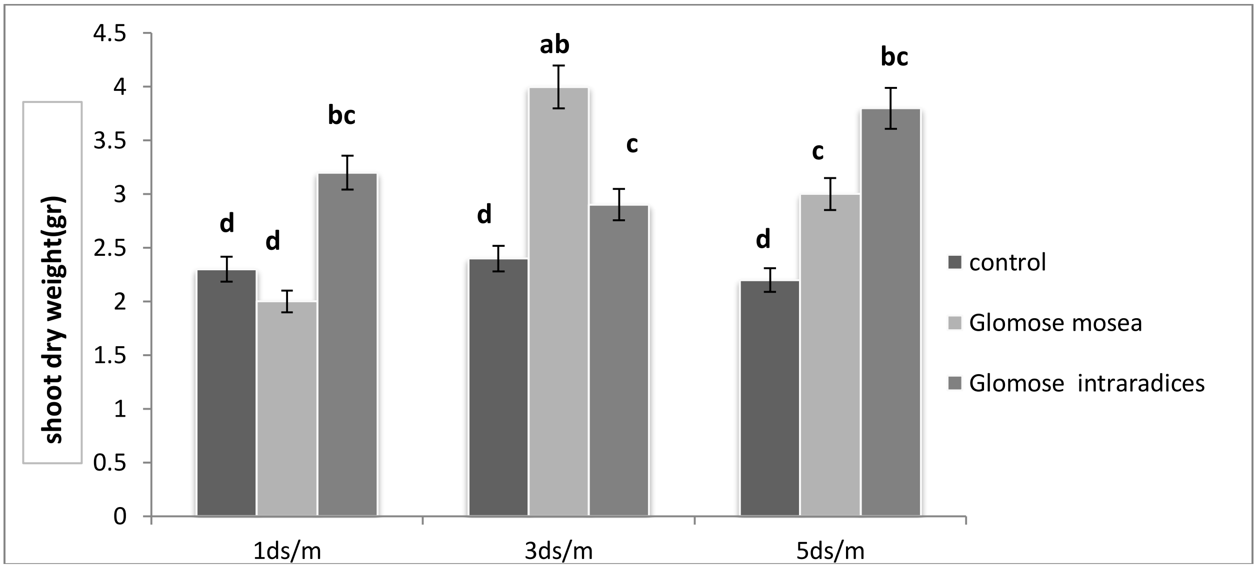

Figure 4. Interaction of salinity stress on mycorrhizal fungi SDW

Duncan test results indicated that, the average Chlorophyll a is more than 3 and 5 ds/m salinity. With increased levels of salinity, chlorophyll a levels are reduced in plants. Average chlorophyll a in each of 3 levels of salinity treated plant is more than control plants of both species. Salinity levels 1 and 5 ds/m, the average chlorophyll a in plants treated with glomos mossa fungus is higher than the plants treated with Glomose intradices . However, the salinity of 3 ds/m Glomose intraradices plants treated with fungi are more than plants treated with the fungus glomos mossa.

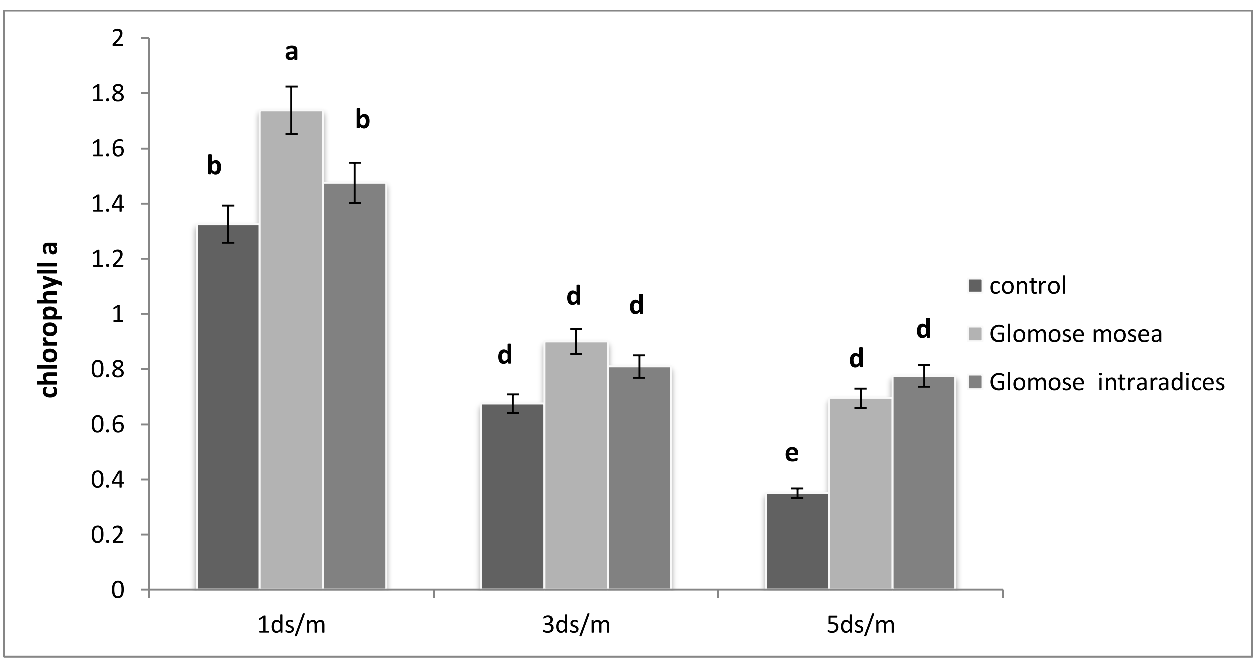

Figure 5. Interactions between mycorrhizal fungi of salt stress on chlorophyll a

Information obtained from the comparison of the mean showd that there was a significant difference between the control group and basil plants treated with two fungi in three levels of salinity. Duncan test results indicated that in the salinity of 1 ds/m the mean of chlorophyll b was more than salinity of 3 and 5 ds/m and chlorophyll b in plants with increasing salinity levels were reduced.

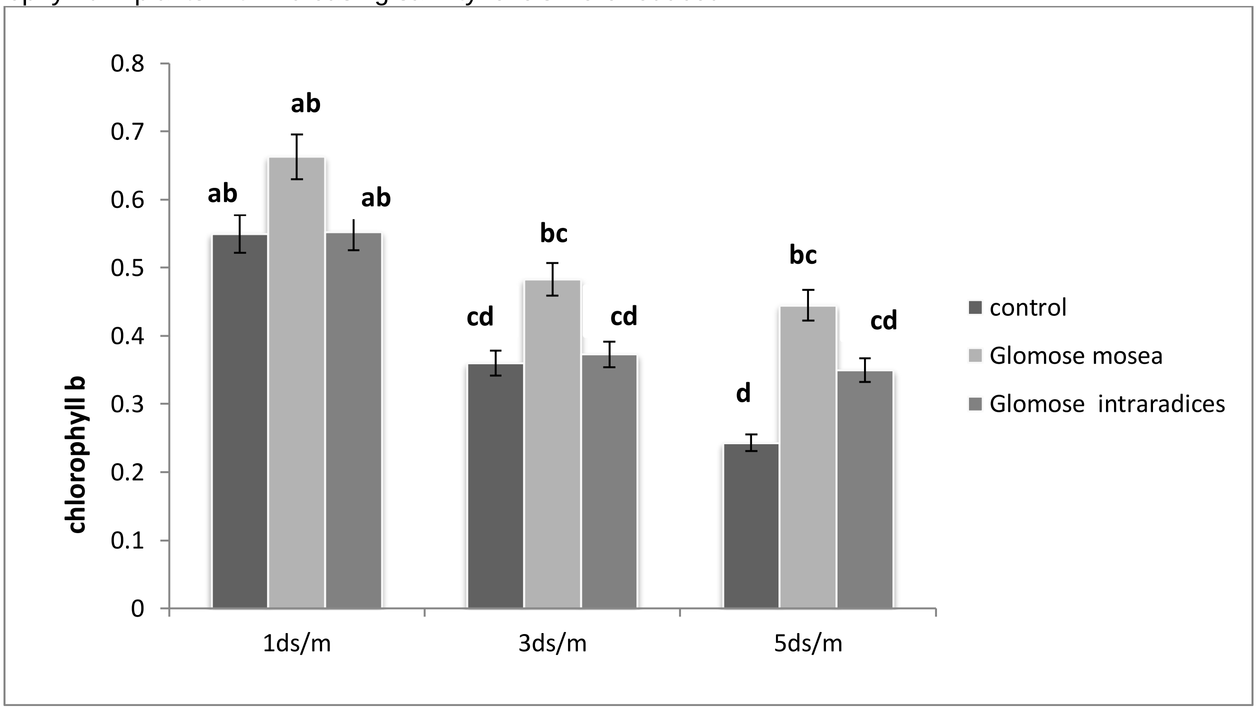

Figure 6. Interactions between mycorrhizal fungi of salt stress on chlorophyll b

Duncan test results indicated that at higher levels of salinity 1 the average of total chlorophyll was more than 3 and 5 ds/m and with increasing salinity levels, the total chlorophyll content reduced in plants. Control groups treated with glomos mossa fungi adopted at Level 1 and 3 ds/m, a significant increase was observed in 5% of the total chlorophyll content, while treated plants with Glomose intraradices only in level 3 ds/m salinity, chlorophyll levels were significantly increased at 5% level. In this experiment, total chlorophyll content and glomos mossa enhancing effects of salt stress compared Glomose intraradices was more obvious.

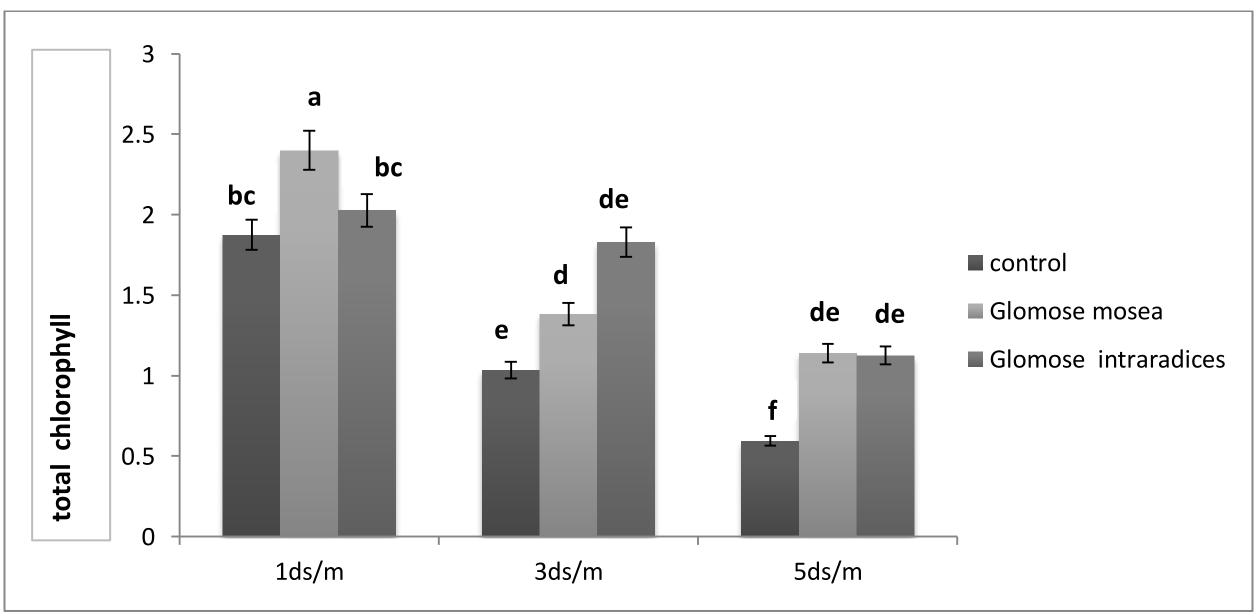

Figure 7. Interaction between mycorrhizal fungi of salt stress on total chlorophyll

Table 2. Analysis of variance

total chlorophyll	Chlorophyll b	chlorophyll a	shoot dry weight	shoot fresh weight	root dry weight	root fresh weight	df	S.O.V
1.098**	0.052**	1.355**	11.737**	2.047	0.436**	0.231	2	Glomos
3.532**	0.14**	1.733**	5.183**	34.003**	0.446**	1.688**	2	NaCl
0.825**	0.003**	0.34**	0.480**	4.404**	0.244**	1.795**	4	Glomos×NaCl
0.149	0.004	0.013	0.088	0.846	0.037	0.26	18	Error
0.82	0.85	0.97	0.95	0.85	0.80	0.70		C.V

* and ** showed significant differences at 5 and 1 %, respectively.

DISCUSSION AND CONCLUSION

Abiotic stresses impact on cell division and reduce the growth. Salinity can lead to reduce plant growth and yield with reducing leaf area (Taiz and Zaygr 1386). In this study, root dry weight increased by increasing salinity and decreasing the osmotic potential of the soil and root fresh weight results in impaired absorption of water decreased by the plants. In a similar report on the fresh weight of roots and shoots of barley to salinity stress decreased with increasing concentration. The reported results ghoulam (2002) correspond to the sugar beet (Ghoulam et al. 2002). Mycorrhizal fungi in plants treated with marked, there was no change in root dry and wet weight and levels of these two parameters only in plants treated with Glomus intraradices under low salt concentration and root dry weight of plants treated with Glomus mosseae in no salt conditions increased under high salinity concentration. That's according to a study Alkraky and colleagues (1997) on wheat inoculated with the fungus Vesicular - Arbuscular did cause an increase in root biomass in mycorrhizal plants under salt stress could increase P uptake in plants (Al-Karaki 1997). Similar results were also observed in shoot and root dry weight and leaf area in non-salt condition (Abbaspour et al. 2005). Jatropha curcas L. under salinity stress on mycorrhizal plants (Ashwani et al. 2010) and maize plants inoculated with Glomus etunicatum under cold stress (Zhu et al. 2010). Also the increase in root dry weight was reported attributed to non mycorrhizal plants.

The results of the study of wet and dry applied in salinity did not show a significant difference but in high salinity levels the shoot fresh weight reduced, which is probably due to reduced water uptake stress. Salinity reduced the weight and number of leaves of oilseed rape (Jamil et al. 2005). Water content in the leaves of cucumber plants under salt stress decreased as the critical factor in water salinity and high salinity was much lower (Stepein and Klobus 2006). It is also reported that in red raspberry, the leaf damage results from accumulation of toxic ions of sodium and chlorine ion imbalance, loss of nutrients and water stress (Wahome 2003). Mycorrhizal plants under salt stress, shoot dry weight was significantly increased compared with control and in non-salt conditions, only Glomus intraradices increased the value of this parameter. The increase in weight was due to the effect of mycorrhizal fungi on nutrient uptake such as nitrogen, calcium, sulfur, potassium, zinc and copper. The use of mycorrhizal fungi increased the plant growth rate and it had an effect on the allocation and transfer of nutrients between roots and shoots, by increasing the nutrient uptake and transport, shoot dry weight increases. Shoot fresh weight in plants treated with Glomus mosseae also increased at low salinity. The mycorrhizal barley plants under salt stress were also obtained similar results (Nourinia et al. 2007). The shoot fresh weight of fungus Glomus mosseae increased the value of this parameter in high salinity, but compared to the control decreased its value in low salinity. And in plants inoculated with Glomus intraradices only at high concentrations of sodium chloride significantly increased the levels of these parameters. Mycorrhizal treatments alone did not show a significant change compared to control. The increasing of shoot dry weight of mycorrhizal plants by mycorrhizal fungi is probably related to the growth hormone synthesis. Hyphae of mycorrhizal fungi are able to produce growth stimulants; they transfer to different parts of the plant after production. It has been reported that with increasing impregnation mycorrhizal plant growth, regulators and vitamins increase in plant growth (Dey et al. 1998). Alkraky et al (2001) studied two varieties of tomato under salt stress with the presence of mycorrhizal fungi. They concluded that the shoot dry weight in both cultivars under salt stress in mycorrhizal plants was more than non mycorrhizal plants. Similar results were obtained about mycorrhizal tomato plants under salt stress conditions by Brin et al (1385). Mycorrhizal fungi in barley leaves also used for shoot growth increased by 30% (Subba-Rao 1998). Mahavar and Alook (2000) reported that onion inoculation with mycorrhizal fungi significantly increased onion bulb; fresh and dry weight of shoot, P content and their function rather than non-inoculated plants (Mahaveer and Alok 2000). In this study, as in many other studies, chlorophyll and carotenoid levels were found to decrease with increasing salinity. Chlorophyll loss is probably due to activation pathway of chlorophyll catabolism. The amount of ethylene increases in salinity; as a result in increased salinity, plant chlorophyll will dramatically reduce the enzyme activity of chlorophillase (Prasad 1996). The reactive oxygen species produced by the decomposition of chlorophyll and chloroplasts are in Salt stress (Sairam et al. 1998). Karimi (2005) reported that the maximum amount of chlorophyll a and b in plant Kochia has been seen in control plants and the highest reduction of salt happened with the concentration of 200 mM NaCl (Karimi et al. 2005). In this study, photosynthetic pigments decreased in salinity which is corresponded with the results obtained from corn (Dela-rosa and Matini 1995) and barley (El-Tayeb 2005). Mycorrhizal fungi with capturing carbon meet its own needs and nutrients that leads to the plant organs growth followed by increasing the carbon assimilation provides the required carbs of fungus.

Mycorrhizal inoculated of plants increased carotenoid levels only in high salinity and inoculation with Glomus mosseae. This research and similar studies indicate that mycorrhizal plants in saline conditions show better growth than non-inoculated plants.

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